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## PARASITES OF THE BLACK SCALE, *SAISSETIA OLEAE*, IN AFRICA<sup>1,2</sup>

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### INTRODUCTION

THE SEARCH for insect enemies of the black scale, *Saissetia oleae* (Bern.), in Africa in 1936-37 was incidental to an exploration made primarily for parasites of the red scale, *Aonidiella aurantii* (Mask.). The trip was financed in part by the citrus growers of California, who, through their organizations, had raised a fund to supplement that provided by the University of California for an exploration of South America for parasites of the red scale in 1934-35. Less than half the fund contributed by the growers was spent on the South American trip; hence, in 1936, H. S. Smith, in charge of beneficial-insect investigations for the University of California, recommended that the remaining portion be used to help finance a trip to Africa for the purpose of obtaining the red-scale parasite, *Habrolepis rouxi* Compere, and any other African parasites that might be of value in California for the control of insects injurious to citrus.

This paper includes an account of the search for the black scale and its parasites in Africa and the collection and shipment of material to California, with descriptions of six new species of chalcidoid parasites.

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<sup>2</sup> Paper no. 416, University of California Citrus Experiment Station, Riverside, California.

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S. E. Flanders<sup>4</sup> handled the propagation and colonization of the material and has contributed biological notes on a number of species. The types of the species described as new are to be deposited in the United States National Museum, paratypes to be deposited in the British Museum of Natural History.

## BLACK SCALE IN AFRICA AND THE SEARCH FOR PARASITES

What was known of the black scale and its parasites in Africa previous to the 1936-37 investigation has been reported in earlier papers (Smith and Compere, 1920, 1926, 1928; Compere, 1931a, 1931c).<sup>5</sup> The status of black scale in Cape Town appears to have changed greatly in recent years. It now occurs in injurious numbers on oleanders in many door-yards in the area extending from Camp's Bay on the Atlantic to Muizenberg on the Indian Ocean. The testimony of all previous investigators is to the effect that in Cape Town the black scale was never found in abundance and that its scarcity there was due to the activity of parasites. The present abundance of black scale in Cape Town is attributed to the activities of the Argentine ant in destroying beneficial parasites. Whether or not the Argentine ant is solely and primarily responsible for the present situation there, is a question which cannot be answered with certainty, but findings in Africa substantiate the belief that it is the most important factor.

In South Africa, black scale so rarely infests citrus as to warrant the statement that it is nonexistent, or nearly so, as an orchard pest in that country. In the writer's opinion, the freedom of citrus from black scale in South Africa is not attributable to the work of parasites. Citrus trees entirely free from black scale were discovered growing side by side with oleanders that were heavily infested. It seems logical to conclude that if parasites were the controlling factor, they would have controlled the black scale infesting the oleanders as well as those infesting citrus. The failure of black scale to develop freely on citrus in Africa is not a unique phenomenon. Nearly all the cosmopolitan scale insects which the writer has investigated show different capacities and infest different plants in different countries, even though the same host plants may be common to all countries. In Brazil, red scale, *Aonidiella aurantii* (Mask.), is practically unknown as a pest of citrus, whereas rose bushes intertwined with citrus may be heavily infested. In Asia, the black scale rarely infests citrus although it can be found on other plants. The list

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<sup>5</sup> See "Literature Cited" at the end of this paper for complete data on citations, which are referred to in the text by author and date of publication.

may be extended and insects other than citrus-infesting coccids be cited as examples.

There are no commercial plantings of citrus in the vicinity of Cape Town, the nearest being at Citrusdal and Clan William, about 150 miles to the north, in a drier and warmer district. There are, however, individual dooryard citrus trees in Cape Town and a few family orchards in the near-by Constantia and Kirstenbosch districts. At Klein Constantia, about an acre is planted to mixed varieties of citrus, including lemons, grapefruit, and oranges. Near by is an old oleander hedge a half mile or so in length. Enough parasitized scales were collected from the oleanders to make a shipment to California, and the live or unparasitized scales were plump, shining, and healthy. A careful search through the near-by citrus resulted in the finding of six wrinkled, unhealthy, brownish-looking black scales without evidence of parasitism.

In general, black scale can almost never be found on citrus in Africa although often it can be found on some other host plant growing in the vicinity of citrus. It tends to fade out and disappear on oleanders in the more humid, hot, coastal regions, but appears on other host plants, especially certain species of *Ficus*.

Black scale was found in abundance by the writer in two localities in the Union of South Africa. It is interesting and significant to note that the severe infestations were correlated with the presence of the Argentine ant, or an ant that appears similar and works just as effectively. The identity of the ant that is exceedingly abundant and a great nuisance to householders in Cape Town is not questioned, but the identity of the one found in association with black scale in Pretoria and in certain sections of Johannesburg needs confirmation, for according to the South African entomologists, the Argentine ant was not known to occur in the Transvaal previously. In the Port Elizabeth and Uitenhage areas, oleanders are very common in dooryards and as hedge plants along roads and sidewalks. In these areas, the Argentine ant is not common, and injurious infestations of black scale were not discovered, although scattered specimens were present almost everywhere.

While black scale is now abundant on oleanders in the gardens of Cape Town, it seems likely that this was not always the case and that probably its changed status is correlated with the increase and spread of the Argentine ant. In conversation, C. P. Lounsbury stated that after the introduction of the Argentine ant into Cape Town in 1902, the black scale seemed to increase in numbers. C. W. Mally stated that in the early days it was very difficult to find enough black scales in Cape Town to make a shipment and that most of the scales on oleanders, shipped to California in those days, came from one garden.



Shortly after the formation of the Union of South Africa in 1910, Lounsbury was appointed Chief Entomologist with headquarters in Pretoria. After the move to Pretoria, Lounsbury did not have the black-scale situation in the Cape Town area under his personal observation. The situation before 1910 is best pictured by the following quotation :

The black scale occurs widely in the Union and perhaps nowhere is it more common, or rather less uncommon than in Cape Town. Though you may have to search rather long before you find much of it. I deemed it to increase very considerably after the Argentine ant became established. Much of the material I sent to California was on *Sparrmannia africana*, an indigenous shrub cultivated in some suburban gardens, but I always considered oleander the most generally infested plant. It was on oleanders in the town itself that the saucer-shaped form used to be found. The *Sparrmannia* (stakoos) may grow wild in the Peninsula but I do not recall ever coming across it there. It occurs on the mountain sides above George and I have seen black scale on it there, just odd individuals. I think that Percy B. Cloete, the plant inspector at Cape Town, will be able to guide you to the garden where we got so much of the material to send to California 30 years ago. The place was then the residence of the late Adrian Van Der Byl. It is beyond the Paradise Estate, toward the mountain from the Kenilworth railway station. Our practice was to band selected branches with tanglefoot to prevent access of Argentine ants to the scales and then after a lapse of weeks when parasites could oviposit without molestation, cut and ship the heavily infested portions of these branches. I mention this now as I think it was in the spring that we found it best to carry on the work.<sup>6</sup>

In unpublished notes prepared by E. W. Rust, some statements are made which seem to show that in Cape Town black scale was more abundant after 1919 than it was before 1910. The observations reported on by Rust are for the years 1919-21 :

During this work a constant search for colonies of black scale was made and many days were spent in a house-to-house search through the region of Cape Town and vicinity. Wherever an infestation was located, it was noted in a book giving such details as location, host plant, size of infestation, condition of scale, amount obtainable for shipment, etc.<sup>7</sup>

In November, 1936, the status of black scale in Cape Town was quite different from that described by Lounsbury, Mally, and Rust in previous years. Hundreds of oleanders scattered throughout the gardens of the city were heavily infested. Samples of the scales from different infestations produced parasites in abundance. The most numerous of the black-scale parasites reared from material collected in Cape Town were species that had already been established in California, namely, *Coccophagus trifasciatus* Compere, *C. ochraceus* Howard, *C. capensis* Compere. Of these, *C. trifasciatus* was by far the most numerous. In some localities,

<sup>6</sup> Lounsbury, C. P. Letter dated from Pretoria, November 9, 1936.

<sup>7</sup> Rust, E. W. Memorandum on file at Citrus Experiment Station, Riverside, California.

scale after scale, with few exceptions, had a slight bulge on the side, indicating the presence of a pupa of *C. trifasciatus* within.

The search for parasitized black scale in the Pretoria-Johannesburg area resulted in the finding of some heavily infested oleanders in door-yards of a semi-industrial district in the city of Johannesburg and one small infestation in the city of Pretoria. Scattered individuals were found in various places throughout the area but not enough for shipment. The shipment made from Johannesburg April 10, and received at Riverside May 1, 1937, which contained black scale collected in Pretoria and Johannesburg, was the most productive one made. The insectary note regarding this shipment states, "Parasites are emerging in great numbers, counts made only of those not plentiful." The stock of *Encyrtus fuliginosus* n. sp., *Diversinervus smithi* n. sp., and *Coccophagus pulvinariae* Compere, now in California, are descendants of specimens obtained from this shipment. In the insectary notes relating to this shipment, mention is made of an *Anicetus*, which remains undescribed. This species was given the opportunity but did not oviposit in *Saissetia oleae*.

Ten days were spent in Natal, mostly in the Durban area, in an unsuccessful search for black-scale parasites. E. W. Rust collected extensively in the Durban area during the years 1925-26. In Natal he found *Saissetia oleae* generally distributed, very scarce, and usually parasitized. The parasites of *S. oleae* collected by Rust in Natal are as follows:

*Coccophagus bivittatus* Compere  
*Coccophagus nubes* Compere  
*Coccophagus pulvinariae* Compere

*Coccophagus specialis* Compere  
*Diversinervus elegans* Silvestri  
*Metaphycus natalensis* Compere

In Rio de Janeiro, Brazil, where the climate is tropical, *Saissetia oleae* can generally be found on certain species of *Cassia* trees but rarely on plants which it commonly infests in temperate countries. *Cassia* trees are comparatively rare in Durban. Although a special search for them was made, the few specimens of *Cassia* that were found were free of black scale. From Durban a trip was made to Laurengo Marques in Portuguese East Africa, via Nongoma, Bremersdorp, and Stegi. Since *Cassia* trees seem to be a favorite of the Portuguese people in this district, Laurengo Marques was considered a likely place in which to find an abundance of *Cassia* trees and possibly parasitized black scale for shipment. Although ants were abundant and *Cassia* and other likely-looking host plants were plentiful, no black scales were discovered.

The time spent searching for parasites of black scale in Natal, Transvaal, and Portuguese East Africa was limited in favor of spending the balance of the traveling fund on a search in British East Africa. All travel in the Union of South Africa and in Portuguese East Africa was



by automobile. Since an automobile was required for work in British East Africa and since it was thought that collecting could be done en route, the trip to Nairobi was made by automobile. Because of unusually prolonged and heavy rains throughout the countries traveled, the journey took longer and was more expensive than anticipated: instead of taking two weeks, it took almost two months to go from Pretoria to Nairobi. With few exceptions, while en route between Pretoria and Nairobi, no time was spent searching for black-scale parasites. After leaving Mzimba in Nyasaland, of necessity, things not entomological became of primary concern until Nairobi was reached. A few specimens of black scale were taken in Southern Rhodesia, Nyasaland, and Tanganyika but not enough to make a shipment, nor did the few specimens collected en route produce any parasites. W. J. Hall, Director of the Mazoe Estates in Southern Rhodesia, exhibited some specimens of *Saissetia oleae* collected locally that contained exit holes made by parasites.

In the spring of 1936, Richard Le Pelley, an entomologist of the Kenya Government, had visited the Citrus Experiment Station at Riverside. In conversation he mentioned having reared parasites from *Saissetia oleae* found on coffee near Nairobi. The desirability of obtaining these parasites was one reason for making the trip to Africa. According to the Kenya entomologists, black scale was exceedingly rare on coffee and when found was usually limited to a few scattered specimens. The black-scale parasites obtained by Le Pelley had been sent to the British Museum for identification.

Oleanders are not commonly grown in Nairobi. The city and suburbs were systematically searched for these plants and in two places in city gardens enough parasitized scales were found on oleander for shipment. In Kenya Colony and Uganda Protectorate, most of the scales collected on oleanders were obtained from the base of main branches below the ground level or beneath dirt and debris that had accumulated about the crown of the plants. All the parasitized black scales shipped to California from Kenya Colony were obtained in the city gardens of Nairobi. Trips were made to other towns and plants examined en route without finding additional sources of material. At the conclusion of the investigation, while waiting at Mombasa for an overdue steamer, some time was spent searching in this area. Oleanders are very common in Mombasa and many seemed ideally situated, hidden in small gardens and yards in densely crowded sections of the old city, but no black scales were discovered by the writer in Mombasa or vicinity. However, a day or so before departure, the writer was shown some specimens of black scale on a *Ficus* sp. collected in Mombasa by A. Melville, a government entomologist who had interested himself in the project.

The following parasites were obtained at Riverside from black scales collected in Nairobi during the month of June, 1937:

<i>Coccidozenus niloticus</i> n. sp.	<i>Coccophagus saintebeauvei</i> Girault
<i>Coccophagus basalis</i> Compere	<i>Coccophagus spectabilis</i> Compere
<i>Coccophagus coracinus</i> n. sp.	<i>Diversinervus elegans</i> Silvestri
<i>Coccophagus eleaphilus</i> Silvestri	<i>Encyrtus fuliginosus</i> n. sp.
<i>Coccophagus nigrifus</i> Compere	<i>Mesopeltis</i> sp.
<i>Coccophagus ochraceus</i> Howard	<i>Metaphycus</i> sp.
<i>Coccophagus rusti</i> Compere	<i>Microterys kenyaensis</i> Compere

During the month of July, 1937, parasitized black scale were collected in Uganda at Jinja, Kampala, Entebbe, Fort Portal, Masaka, and Tororo. In addition to oleanders, black scale was found on *Ficus dekdekana*, *Ficus* sp., *Tephrosia* sp., *Citrus* sp., *Psidium* sp., and on four species of *Cassia*. The most productive find was made at Masaka near a dwelling where the aerial roots of a fig tree were covered by refuse dumped from a window. Beneath the accumulations of refuse, the concealed and almost inaccessible aerial roots were heavily infested with black scale. A good proportion of the scales had already been killed by parasites; others were plump and alive. At the botanical garden in Entebbe are many different kinds of *Cassia* trees. The black scale was found on these, but its occurrence was rare. All the specimens on *Cassia* were discovered in crevices, around pruning scars, or where two branches were in close contact. With few exceptions, the scales collected on oleanders were found beneath loose soil at the crowns. At Tororo, a small cluster of black scale was found in the shelter provided between two touching citrus fruits. On the highway between Entebbe and Kampala is an isolated small stunted *Ficus dekdekana*, or similar-appearing species. This tree was generally lightly infested, the scales being mostly on the leaves and small twigs. Several specimens of *Metaphycus* were noticed on the scale-infested leaves of the *Ficus* but escaped capture.

The following species of parasites were reared at the insectary in Riverside from *Saissetia oleae* collected in Uganda:

<i>Coccophagus coracinus</i> n. sp.	<i>Diversinervus elegans</i> Silvestri
<i>Coccophagus eleaphilus</i> Silvestri	<i>Diversinervus masakaensis</i> n. sp.
<i>Coccophagus flavidus</i> n. sp.	<i>Mesopeltis</i> sp.
<i>Coccophagus rusti</i> Compere	<i>Metaphycus</i> sp.
<i>Coccophagus saintebeauvei</i> Girault	

#### METHOD OF SHIPPING AND PACKING PARASITIZED BLACK SCALES

The establishment in recent years, by Imperial Airways, of regular air transportation from Southampton, England, through British East Africa and the Rhodesias to the Union of South Africa greatly simpli-

fied the shipment of material from Africa to California. When Lounsbury first began to ship black-scale material from Cape Town to San Francisco in 1901, shipments were en route two months or more. E. W. Rust made shipments from Cape Town to California during the years 1919-1921 and 1922-1926; his shipments usually were en route about six weeks, occasionally about one month. Shipments en route more than one month rarely produced live parasites.

When the 1936-37 shipments were made, it was possible to ship express parcels from Cape Town to Riverside in 18 days, and from Nairobi to Riverside in less time, provided prompt reshipment could be made at Southampton on a fast trans-Atlantic steamer. The material shipped from various places in Africa was collected and packed just before the scheduled departure of the transport planes. It was delivered to Imperial Airways at their airports in Africa and consigned to the American Express Company at Southampton. American Express was notified by cable or by previous air mail when shipments were due at Southampton. At Southampton, American Express forwarded the parcels on the first steamer bound for New York and notified the United States Dispatch Agent, who met the incoming steamer, immediately cleared the shipment, and promptly forwarded it to Riverside.<sup>8</sup>

In preparation for shipment, branches and twigs infested with parasitized scales were cut into 1- to 3-foot lengths and loosely wrapped in ordinary newspaper so as to prevent rubbing and to provide plenty of air space. The bundles were then loosely packed in heavy paper cartons or in tin boxes, sealed, tightly wrapped in several thicknesses of heavy canvas, and securely roped.

### PROPAGATION AND COLONIZATION OF BLACK-SCALE PARASITES

Between November 27, 1936, and July 13, 1937, twenty-four lots of live beneficial insects were shipped from Africa to California for propagation and colonization. Eleven of these shipments contained parasitized black scale, eight shipments contained parasitized red scale, and five shipments were made up of mixed lots of parasitized black scale, red scale, and mealybugs.

No samples of parasitized black scales were retained in Africa for test rearings except in Cape Town, where more than enough material was available for shipment. It was considered wasteful to retain black scale

<sup>8</sup> The success in sending parcels of living insects from Africa to California by air transport was made possible by the coöperation of the United States Dispatch Agent at New York, H. Fife, and by officials of the Imperial Airways and of the American Express Company at Southampton.



in Africa for the purpose of securing records if the scales were thought to contain parasites that were wanted for trial in California. For this reason, what parasites had been collected and shipped were often not known until rearings were made at Riverside. Flanders, who handled the parasites at Riverside, did not kill and preserve for identification specimens that were rare and of potential value but liberated them in cages in the quarantine room in an effort to secure reproduction.

From the black-scale material, Flanders obtained living specimens of twenty-eight species, all of which are supposed to be primary parasites. Five of these species had already been established in California:

<i>Coccophagus capensis</i> Compere	<i>Metaphycus lounsburyi</i> (Howard)
<i>Coccophagus ochraceus</i> Howard	<i>Scutellista cyanea</i> Motschulsky
<i>Coccophagus trifasciatus</i> Compere	

Some of the parasites were too weak upon arrival in Riverside to permit reproduction; others failed because of want of males at the proper time. Ten species not previously colonized in California were successfully propagated. Colonies of these parasites were released in the orchards infested with black scale, and breeding stock was supplied to the local insectaries. These ten species are the following:

<i>Coccidoxenus niloticus</i> n. sp.	<i>Encyrtus fuliginosus</i> n. sp.
<i>Coccophagus cowperi</i> Girault	<i>Mesopeltis</i> sp.
<i>Coccophagus pulvinariae</i> Compere	<i>Metaphycus helvolus</i> (Compere)
<i>Coccophagus rusti</i> Compere	<i>Metaphycus stanleyi</i> Compere
<i>Diversinervus smithi</i> n. sp.	<i>Microterys saissetiae</i> Compere

All the newly introduced species reproduced in one or more of the black-scale-infested orchards where they were released. Of these species, four now appear to be permanently established in California, namely, *Metaphycus helvolus*, *M. stanleyi*, *Coccophagus rusti*, and *C. pulvinariae*.

The thirteen species received at Riverside which were not propagated are the following:

<i>Coccophagus anthracinus</i> Compere	<i>Coccophagus spectabilis</i> Compere
<i>Coccophagus basalis</i> Compere	<i>Diversinervus elegans</i> Silvestri
<i>Coccophagus coracinus</i> n. sp.	<i>Diversinervus masakaensis</i> n. sp.
<i>Coccophagus eleaphilus</i> Silvestri	<i>Euxanthellus</i> sp. <sup>9</sup>
<i>Coccophagus flavidus</i> n. sp.	<i>Metaphycus</i> sp.
<i>Coccophagus nigritus</i> Compere	<i>Microterys kenyaensis</i> Compere
<i>Coccophagus saintebeauvei</i> Girault	

<sup>9</sup> Previous to Flanders' discovery of the hyperparasitic habits of male *Coccophagus*, the writer recorded *Euxanthellus philippiae* Silvestri as an injurious hyperparasite, on the basis of what are now known to be insufficient data. The host relations of the females of *Euxanthellus* spp. are still uncertain.

Six species of chalcidoid parasites known to attack black scale in Africa were not obtained from the 1936-37 shipments:

<i>Coccophagus baldassarii</i> Compere	<i>Coccophagus nubes</i> Compere
<i>Coccophagus bivittatus</i> Compere	<i>Coccophagus specialis</i> Compere
<i>Coccophagus eritreensis</i> Compere	<i>Metaphycus natalensis</i> Compere

Exclusive of the species of Eupelmidae, which are not included in this article, a total of thirty-three species of chalcidoids are now known to be primary parasites of black scale in Africa. This, as well as other evidence, indicates that the black scale is indigenous to Africa and that it has been transported by commerce to other parts of the world.

### SPECIES OF COCCOPHAGUS PARASITIC IN BLACK SCALE<sup>10</sup>

#### Key to the Species, Females

- |  |    |
|--|----|
| 1. Scutellum with three pairs of setae.....  | 2  |
| Scutellum with more than three pairs of setae, usually as densely setose as the mesoscutum .....   | 13 |
| 2. Pedicel as long or longer than the first funicle joint.....   | 3  |
| Pedicel plainly shorter than first funicle joint.....  | 6  |
| 3. Thorax and abdomen without a broad, longitudinal brown stripe on either side .....  | 4  |
| Thorax and abdomen with a broad, longitudinal brown stripe on either side; Natal .....   | 4  |
| <i>bivittatus</i> Compere, p. 397  |    |
| 4. Head, thorax, and abdomen dominantly yellow with darker markings.....   | 5  |
| Head and thorax black, abdomen mostly black, the base yellow; Brazil, Kenya Colony .....   | 5  |
| <i>basalis</i> Compere, p. 397   |    |
| 5. Abdomen with a clearly defined, wide black band across the dorsum posterior to the middle; south Africa, California, Eritrea. <i>ochraceus</i> Howard, p. 398 |    |
| Abdomen with brownish suffusion on the dorsum, the apex pale; Kenya Colony .....   | 5  |
| <i>flavidus</i> n. sp., p. 398   |    |
| 6. Forewings without a well-defined fuscous cloud across the blade beneath the marginal vein .....   | 7  |
| Forewings with a well-defined fuscous cloud across the blade beneath the marginal vein; South Africa, Kenya Colony, Uganda. <i>rusti</i> Compere, p. 399         |    |
| 7. Dominantly black .....  | 8  |
| Dominantly yellow to pearly white, sides of abdomen longitudinally spotted or banded with brown; Natal.....  | 8  |
| <i>specialis</i> Compere, p. 400   |    |
| 8. Scutellum yellow or partly yellow.....  | 9  |
| Scutellum completely black.....  | 12 |
| 9. Forelegs more or less blackish to brown.....  | 10 |
| Forelegs completely pale lemon yellow.....   | 11 |
| 10. Tibiae of hind legs completely yellow; Cape Province. <i>cowperi</i> Girault, p. 400   |    |
| Tibiae of hind legs mostly blackish to dark brown, the ends paler; Eritrea, Uganda .....   | 10 |
| <i>eleaphilus</i> Silvestri, p. 400  |    |

<sup>10</sup> Three species of *Coccophagus* which attack black scale but are not known from Africa are included in this key, namely, *Coccophagus fallax*, *C. heteropneusticus*, and *C. yoshidae*.

11. Femora of hind legs pale lemon yellow; Natal,  
Transvaal ..... *pulvinariae* Compere, p. 401
- Femora of hind legs mostly blackish to brown;  
Eritrea ..... *eritreensis* Compere, p. 401
12. Legs dominantly yellow with middle and hind coxae and hind tibiae more or  
less dark brown to black; Eritrea ..... *baldassarii* Compere, p. 401
- Legs dominantly black grading to dark brown; southwestern section of Cape  
Province ..... *anthracinus* Compere, p. 401
13. Pedicel plainly shorter than the first funicle joint. .... 14
- Pedicel slightly longer than the first funicle joint; South Africa,  
California ..... *trifasciatus* Compere, p. 402
14. Forewings without a large, distinct fuscous cloud beneath the marginal vein 15
- Forewings with a large, distinct fuscous cloud beneath the marginal vein. . . 19
15. Scutellum completely black or only the extreme apex yellow. .... 16
- Scutellum extensively yellow, more or less black basally;  
Brazil ..... *fallax* Compere, p. 402
16. Femora of hind legs mostly black. .... 17
- Femora of hind legs entirely pale lemon yellow; Uganda, Kenya Colony, Eri-  
trea, and the eastern section of Cape Province. *saintebeauwei* Girault, p. 402
17. Femora of hind legs entirely black. .... 18
- Femora of hind legs with apical one third or so yellow; Kenya Colony, Eri-  
trea, Natal ..... *nigritus* Compere, p. 402
18. Submarginal vein almost as long as the marginal vein;  
Brazil, Argentina. .... *heteropneusticus* Compere, p. 403
- Submarginal vein not much more than one half as long as the marginal vein;  
Japan ..... *yoshidae* Nakayama, p. 403
19. Thorax dominantly black. .... 20
- Thorax dominantly yellow; Natal. .... *nubes* Compere, p. 403
20. Abdomen black or dark brown, without yellow basal corners. .... 21
- Abdomen black with the basal corners yellow in sharp contrast; Natal, Eri-  
trea, Kenya Colony, Uganda. .... *spectabilis* Compere, p. 403
21. Coxae of hind legs dominantly black or dark brown. .... 22
- Coxae of hind legs white with a faint dusky suffusion on the dorsum;  
Uganda ..... *coracinus*, n. sp., p. 404
22. Ovipositor extending from near the middle of the abdomen to the apex;  
South Africa ..... *capensis* Compere, p. 405
- Ovipositor extending from the base of the abdomen to the apex; Natal, Kenya  
Colony, Eritrea. .... *nigritus* Compere, p. 402

#### COCCOPHAGUS BIVITTATUS COMPERE

*Coccophagus bivittatus* Compere (1931b, p. 73-74).

*Coccophagus bivittatus* is a rare species, originally collected by E. W. Rust at Durban, Natal, and Cape Town, Union of South Africa. Only males were reared from black scale. It is possible that *C. bivittatus* does not develop in *Saissetia oleae* as a primary parasite.

#### COCCOPHAGUS BASALIS COMPERE

*Coccophagus basalis* Compere (1939b, p. 86-87).

Flanders reared at Riverside five females from black-scale material collected at Nairobi, Kenya Colony, sent June 19, and received July 3,



1937; insectary no. A-207.<sup>11</sup> The attempt to propagate the species was unsuccessful. One specimen was saved for identification. This specimen appears indistinguishable from specimens obtained from black scale collected near Rio de Janeiro, Brazil, in 1934, and described as *Coccophagus basalis*.

#### COCCOPHAGUS OCHRACEUS HOWARD

*Coccophagus ochraceus* Howard (1895, p. 38).

*Coccophagus bifasciaticorpus* Girault (1916b, p. 44).

*Coccophagus ochraceus*. Gahan (1924, p. 13). Smith and Compere (1928, p. 259-61). Compere (1931a, p. 250). Cendaña (1937, p. 359-71).

*Coccophagus ochraceus* is very common in the Cape area of South Africa. It was also abundant in black scale collected in Johannesburg and Pretoria, as shown by the insectary records. It occurs in British East Africa and Eritrea. In California, *C. ochraceus* is one of the commonest parasites of black scale.

#### COCCOPHAGUS FLAVIDUS N. SP.

*Coccophagus flavidus* n. sp. is related to *C. ochraceus* and its allies. It can be distinguished from *C. ochraceus*, to which it is most closely related, by color, vestiture of thorax, and by the wings. In *C. ochraceus* the forewings are slightly more than twice as long as wide, the longest cilia of the marginal fringe are about one tenth as long as the greatest width of the blade, and the mesoscutum is densely setose. In this species the forewings are almost three times as long as wide, and the longest cilia of the marginal fringe are about one fifth as long as the greatest width of the blade; the marginal fringe of hind wings is as long or longer than the width of the blade; and the mesoscutum is sparsely setose.

*Female*.—General color honey yellow; face probably white, but this cannot be determined with certainty. Occiput above neck, most of pronotum, metanotum, propodeum, and most of dorsum of thorax brown. Parapsides blotched with brown in the middle; axillae slightly suffused with brown. Scape mostly white, dorsal margin faintly dusky. Flagellum faintly brownish. Eyes and ocelli carmine. Legs whitish to faintly yellowish, tibiae faintly dusky toward the base.

Pediceal one and one-half times as long as wide. First funicle joint the smallest, about as long as wide and one half as long as the pedicel. Third funicle joint about one and one-third times as long as wide; second funicle joint intermediate in size. Club large, much wider than the preceding joint and longer than the three preceding joints united. (Antennae not entirely describable because of poor mounting.)

Scutellum plainly wider than long (5:3). Tibial spur of middle legs longer than basitarsus (8:5). Ovipositor short, from base to apex as long as hind tibiae; ovi-

<sup>11</sup> Biological note by S. E. Flanders: The first-instar larvae from unfertilized eggs of *Coccophagus basalis* are similar in form to the male planidia of *C. trifasciatus*. This indicates that the male of *C. basalis* is an indirect hyperparasite.

positor very shortly exerted (protrusion may be due to pressure from cover slip). Mesoscutum with approximately thirty-four rather coarse setae, two large setae near posterior margin fully as strong as those on scutellum. Scutellum with three pairs of setae of nearly uniform size. Each axilla and each parapside with two coarse setae.

Length, 0.7 mm.

Described from one female, holotype, mounted in balsam and slightly distended owing to pressure of cover slip. This specimen bears insectary no. A-209, which refers to a shipment of black scale on oleanders collected at Tororo.

This single specimen is of particular interest, since it is the only specimen of a species whose work was seen at Tororo. In the compound of the railway station at Tororo, an oleander was found blackened with soot and thickly covered with black scales of all stages. Nearly all the scales were dead, except crawlers and first-stage scales on the leaves. Nearly all the larger-sized and adult scales showed exit holes. A good portion of the very small scales, apparently first-stage, showed exit holes, and some contained live parasites.

Two females were reared at Riverside from material collected at Tororo, Uganda, July 2, 1937. According to S. E. Flanders, these parasites were provided with first-stage black scales, but showed no interest in them. It is suspected that unmated females oviposit only when the scales are inhabited by larvae or pupae of chalcidoids.

Tororo is at an elevation of 3,861 feet, near the Kenya-Uganda frontier, about 20 miles or so south of the base of Mount Elgon. Since it is less than  $11\frac{1}{2}^{\circ}$  from the equator, the climate is tropical.

#### **COCCOPHAGUS RUSTI COMPERE**

*Coccophagus rusti* Compere. Smith and Compere (1928, p. 261-62). Compere (1931b, p. 30-31).

*Coccophagus rusti* was the most widely distributed and most frequently reared of the black-scale parasites collected by the writer in Africa. It was reared in abundance from material collected at Pretoria and Johannesburg in March, 1937, and it propagated freely in the insectary at Riverside. It was present in most of the succeeding shipments from Kenya and Uganda and was collected at Uitenhage and Port Elizabeth. In Nairobi, it was reared from a *Coccus* infesting a *Tecoma*, as well as from black scale.<sup>12</sup> Its widespread distribution in Uganda is shown by the insectary rearings. Rather curiously, *Coccophagus rusti* has never been collected in the Cape Peninsula. E. W. Rust reared this species

<sup>12</sup> Biological note by S. E. Flanders: *Coccophagus rusti* also develops in soft brown scale, *Coccus hesperidum* (Linn.). The female is a solitary parasite in half-grown scale insects. The life cycle of the female, at about 80° F, is 20 days. The male is a direct secondary endoparasite. The first-instar male is teleaform, with a pair of ventral spines on the third thoracic segment. This parasite thrives in the presence of the Argentine ant.

frequently from material collected in Natal and made shipments to California at intervals between 1923 and 1926, but at that time no living specimens were obtained for propagation.

#### COCCOPHAGUS SPECIALIS COMPERE

*Coccophagus specialis* Compere (1931b, p. 46-47).

*Coccophagus specialis*, originally described from black scale collected at Durban, Natal, by Rust in 1927, was neither collected by the writer nor reared at Riverside by Flanders from African material.

#### COCCOPHAGUS COWPERI GIRAULT

*Coccophagus flavoscutellum* Masi (not Ashmead). Masi (1907, p. 239).

*Coccophagus cowperi* Girault (1917, p. 1).

*Coccophagus lecanii*. Gahan (1927, p. 24). Smith and Compere (1928, p. 247-54).

*Coccophagus cowperi*. Compere (1931b, p. 57).

The species dealt with here under the name *Coccophagus cowperi* is a common parasite of black scale in the Cape Peninsula region. It was obtained by Flanders from black scales received from Cape Town and was propagated at Riverside.<sup>13</sup>

#### COCCOPHAGUS ELEAPHILUS SILVESTRI

*Coccophagus eleaphilus* Silvestri (1914, p. 318). Mercet (1930, p. 221). Compere (1931b, p. 63; 1931a, p. 254).

From black scale collected at Jinja, Uganda, July, 1937, Flanders reared at Riverside ten specimens of a species which has been identified as *Coccophagus eleaphilus*. What appears to be the same species was obtained by the writer in Eritrea in 1930.

In a paper reporting on some Chalcidoidea from Africa, Mercet (1930) recorded a species under the name *Coccophagus eleaphilus*. Mercet's specimens were reared from *Saissetia oleae* infesting *Ficus dekdekana* and from *Coccus longulum* (Dougl.) infesting *Acacia cyanophylla*. Mercet described the males as having the legs yellow with the tibiae only more or less brownish.

What appears to be the same species was reared from *Ceroplastes destructor* Newst. and *Ceroplastes* sp. collected at Kampala, Uganda, by

<sup>13</sup> Biological note by S. E. Flanders: *Coccophagus cowperi* is a solitary parasite in scale about one-third grown. The male is a direct secondary ectoparasite. The eggs of unmated females are fastened by means of a stalk to the outer surface of parasitic hymenopterous larvae or pupae enclosed in their cocoons within the host scale. The first- and second-instar larvae differ greatly in structure in the two sexes, since they are adapted to different types of environments. When the female is in the prepupal state, the dorsum of the host prematurely turns black. The life cycle, at about 80° F., is 19 days. This species is valuable as a host for the propagation of the males of *C. trifasciatus*.



Taylor in 1935 and submitted for determination by N. S. Noble, Department of Agriculture, New South Wales. These specimens are recorded under Noble's no. 6.

#### **COCCOPHAGUS PULVINARIAE COMPERE**

*Coccophagus pulvinariae* Compere (1931b, p. 53-54).

From black scales collected in Pretoria and Johannesburg, Flanders reared and propagated a species of *Coccophagus* in appearance similar to *cowperi*, except that the middle and hind coxae are more or less black and the remainder of the legs light lemon yellow. This form seems to be indistinguishable from *Coccophagus pulvinariae*, originally described from specimens reared from hosts other than black scale, collected in Natal by Rust.<sup>14</sup>

#### **COCCOPHAGUS ERITREAENSIS COMPERE**

*Coccophagus eritreaensis* Compere (1931a, p. 254).

The form described under the name *Coccophagus eritreaensis* appears similar to *C. pulvinariae* in the female sex, except that the femora of the hind legs are mostly brownish. *C. eritreaensis* was reared from infestations of *Saissetia cuneiformis* Leonardi and *Coccus hesperidum* (Linn.) in which a few *S. oleae* were mixed; hence, it is not known for certain that this form developed in *S. oleae*.

#### **COCCOPHAGUS BALDASSARII COMPERE**

*Coccophagus baldassarii* Compere (1931a, p. 252).

*Coccophagus baldassarii*, originally reared from *Saissetia oleae* collected in Eritrea in 1930, has not been taken since.

#### **COCCOPHAGUS ANTHRACINUS COMPERE**

*Coccophagus anthracinus* Compere (1925, p. 309-11; 1926, p. 11; 1931b, p. 26-28).

The insectary records show that Flanders obtained five specimens of *Coccophagus anthracinus* from the 1936-37 shipments. Samples retained in Cape Town, of the material shipped to California, produced this species from scales collected at Camp's Bay near Cape Town.

*Coccophagus anthracinus* was in at least one of the shipments of black scale made by Rust from Cape Town in 1923. At that time about 2,000 specimens were propagated and colonized in California, but so far as known, this species did not become established.

According to Flanders, it is suspected that *Coccophagus anthracinus* may be a host suitable for the development of the males of *C. trifasciatus*, and further attempts to establish the species are contemplated.

<sup>14</sup> Biological note by S. E. Flanders: The life history of *Coccophagus pulvinariae* is similar to that of *C. cowperi*. When both species are reared in the same cage, *C. pulvinariae* ultimately replaces *C. cowperi*.

**COCCOPHAGUS TRIFASCIATUS COMPERE**

*Coccophagus trifasciatus* Compere (1925, p. 311-13). Smith and Compere (1926, p. 53). Mercet (1927, p. 496). Smith and Compere (1928, p. 263). Cendaña (1937, p. 372-79). Flanders (1937, p. 403-22).

In Cape Town and vicinity, *Coccophagus trifasciatus* is one of the commonest parasites of *Saissetia oleae*. It was exceedingly abundant in November and December of 1936. It was established in Riverside, California, in 1925, as the result of a sending made by Rust and now occurs in various places in the vicinity of Riverside. Repeated efforts to hasten the spread of this species by transferring colonies to other black-scale-infested districts have not been successful. The failure of this species to control black scale in California has been a disappointment as well as a puzzle.<sup>15</sup>

**COCCOPHAGUS FALLAX COMPERE**

*Coccophagus fallax* Compere (1939b, p. 84).

*Coccophagus fallax* is a species reared from *Saissetia oleae* collected in Brazil.

**COCCOPHAGUS SAINTEBEAUVEI GIRAULT**

*Coccophagus saintebeauvei* Girault (1917, p. 1). Compere (1931b, p. 85-86; 1931a, p. 251).

From black scale collected in Kenya and Uganda, Flanders obtained nine live females of *Coccophagus saintebeauvei*, as shown by insectary notes nos. A-207, A-208, and A-210.

A large number of *Coccophagus saintebeauvei* were reared in 1930 from black scale collected in Eritrea. This species is exceedingly variable in color. The scutellum may be entirely black or black with apex yellow.

**COCCOPHAGUS NIGRITUS COMPERE**

*Coccophagus nigrinus* Compere (1931b, p. 81-82).

*Coccophagus* sp. Compere (1931a, p. 253).

In *Coccophagus nigrinus*, the forewings may be distinctly infuscated or noninfuscated. The legs may be as originally described or mostly blackish with the distal fourth of the middle and hind femora pure yellow in striking contrast. Because of the noninfuscated wings and yellow-tipped femora, the Kenya samples cannot be identified by the characters given in an earlier key to the species (Compere, 1931b). The Kenya samples were identified by comparison with specimens obtained in Eritrea, which exhibit variations.

A brief account of the occurrence of this species in Eritrea is given

<sup>15</sup> Biological note by S. E. Flanders: The reproduction of *Coccophagus trifasciatus* is dependent upon the presence of those species of *Coccophagus* having the habits of *C. cowperi*, *C. lycimnia* (Walker), and similar species, which serve as hosts of the male of *C. trifasciatus*. The female is a solitary parasite of second- and third-stage black scale.

in a previous publication (Compere, 1931a). In that paper, *Saissetia oleae* was questionably regarded as a host. This species was reared at Riverside from *S. oleae* infesting oleanders collected at Nairobi, Kenya Colony, June 18, 1937. The insectary notes, under no. A-207, record the rearing of two live females. Others had issued en route and died.

#### COCCOPHAGUS HETEROPNEUSTICUS COMPERE

*Coccophagus heteropneusticus* Compere (1939b, p. 83-84). Flanders (1939b, p. 888-90).

*Coccophagus heteropneusticus* is known only from South America, where it was found parasitizing *Saissetia oleae*.

#### COCCOPHAGUS YOSHIDAE NAKAYAMA

*Coccophagus yoshidae* Nakayama (1921, p. 98-99). Compere (1924, p. 119; 1931b, p. 94-95).

*Coccophagus yoshidae* is known only from Japan, where it attacks species of *Coccus*. Attempts were made to establish *Coccophagus yoshidae* in California. Females were interested in black scale and seemed to oviposit, but no progeny was secured.

#### COCCOPHAGUS NUBES COMPERE

*Coccophagus nubes* Compere. Smith and Compere (1928, p. 257-58). Compere (1931b, p. 83-85).

*Coccophagus nubes*, discovered by Rust in Natal, where *Saissetia oleae* is recorded as one of its hosts, was not collected during the recent African exploration.

#### COCCOPHAGUS SPECTABILIS COMPERE

*Coccophagus spectabilis* Compere (1931b, p. 86-88).

*Coccophagus* sp. Compere (1931a, p. 254-55).

*Coccophagus spectabilis*, a distinctive species, was originally reared from *Saissetia persimilis* Newst. by Rust in Natal, February, 1927. In May, 1930, a series of specimens was reared from *S. oleae* infesting *Croton macrostachys* at Giglasciu, Ežtaclesan, and Asmara in Eritrea. In June, 1937, the same species was taken on an oleander infested with black scale in the grounds of the Salisbury Hotel, Nairobi, Kenya Colony; and in July obtained from *S. oleae* infesting trees labeled *Cassia grandis*, *C. mosehata* [*moschata* ?], and *C. jajanica* [*javanica* ?] in the botanical garden at Entebbe, Uganda.

At Riverside two live specimens were obtained from shipment no. A-209, from Uganda, and eleven dead females were recovered from shipment no. A-208, which was collected in Nairobi.

The color of this species is variable. In some specimens the thorax is strongly suffused with testaceous coloring and in other specimens it is completely black.



## COCCOPHAGUS CORACINUS N. SP.

*Coccophagus coracinus* n. sp. is a moderate-sized, slender species with setose scutellum and infuscated wings. The white hind coxae are in striking contrast to the black color.

*Female*.—Body shining raven black; frontovertex and face with a slight ferruginous admixture; antennae black; legs mostly black, hind coxae pale white with a narrow dorsal black streak; tarsi of middle and hind legs white except most of first joints, which are black basally; ends of middle femora slightly brownish or pale; distal end of front femora, most of tibiae and tarsi, dark brown. Forewings with a distinct fuscous cloud extending across blade beneath apical half of marginal vein, the cloud curving outward slightly beyond the stigmal vein.

Pediceal short, longer than wide (5:3) and about one half as long as first funicle joint. First funicle joint the longest, slightly more than twice as long as wide (9:4), the second and third decreasing slightly in length and increasing slightly in width. Club relatively short, as long as the scape, the first club joint a trifle wider than the preceding funicle joint. The sensoria unusually slender and sparse, on the funicle about one half as long as the joints; on the first funicle joint usually two sensoria and not more than four visible in one plane; on the second and third funicle joints six sensoria in focus at a magnification sufficiently high to reveal them clearly; on the club, sensoria more numerous, extending almost the entire lengths of the segments. Flagellum clothed with dense, short, coarse black setae.

Forewings more than twice as long as wide (7:3); except basally, densely and uniformly clothed with long black cilia; near the base posteriorly a small part of the blade bare; near the posterior margin of the blade, the fuscous cloud interrupted by a lighter streak. Submarginal vein plainly much shorter than the marginal vein (2:3), the latter furnished with ten or so coarse, black setae; postmarginal vein slightly but distinctly developed.

Scutellum wider than long (23:19) and a trifle shorter than mesoscutum. In shrunk, tag-mounted specimens, the abdomen appears about as long as the thorax, slender, and the ovipositor not exerted. Legs slender, tarsal joints unusually long; basitarsus of middle legs almost as long as the succeeding four joints combined; tibial spur long and slender but shorter than basitarsus. Base of middle tibiae with a group of five or so coarse, short, black setae on outer aspect; outer aspect of hind tibiae with short, coarse setae, but these not so much enlarged as in many other species. Each axilla with two setae comparable in size to those along lateral margins of mesoscutum. Mandibles broad, almost edentate, a slight emargination at the apex giving in some views a bidentate effect.

Length, 1.9 mm.

Described from seven females (holotype and paratypes), two of which were collected on table in laboratory where *Saissetia oleae* material was being packed for shipment at Nairobi, Kenya Colony, June 23, 1937, and five specimens which issued from shipment no. A-212 at Riverside and were dead upon arrival.

The insectary records show that this species was present in six of the shipments of *S. oleae* originating in Kenya and Uganda. This material was collected at Fort Portal, Tororo, Jinja, Entebbe, and Masaka, all in Uganda, and at Nairobi in Kenya during June and July, 1937. A total

of fifteen living specimens of this species were obtained at Riverside. These were liberated in cages containing black scale, but the parasites did not reproduce.

### COCCOPHAGUS CAPENSIS COMPERE

*Coccophagus modestus* Smith and Compere (not Silvestri). Smith and Compere (1926, p. 51-61).

*Coccophagus modestus* var. *capensis* Compere (1931b, p. 83).

*Coccophagus capensis*. Cendaña (1937, p. 390-99). Flanders (1937, p. 403-22).

The South African parasite of *Saissetia oleae* formerly known as *Coccophagus modestus* Silvestri and later tentatively classified as *C. modestus* var. *capensis* is believed to be different from the species described by Silvestri as *C. orientalis* var. *modestus*, from specimens reared from *S. nigra* (Nietn.) collected at Dahomey, West Africa.

If not actually the most numerous, *Coccophagus capensis* was the most noticed and widely distributed parasite of black scale found in the Cape section of South Africa. A few specimens were reared from black scale collected at Port Elizabeth and Uitenhage. This parasite was not reared at Riverside from material in any shipment exclusive of those from Cape Town. It was usually present in abundance where the black scale was found, from Camp's Bay on the Atlantic, skirting the base of Table Mountain, to Muizenberg on the Indian Ocean. A few scattered specimens of *Saissetia oleae*, taken on wild olives in relatively bare country at the foot of Versfeld's Pass beyond Piquetberg, produced *C. capensis* only, as did scales collected individually, or in small scattered groups taken on wild olives and *Podocarpus* near Paarl and Stellenbosch.

In the collection of the Citrus Experiment Station are specimens which the writer is unable to distinguish from those from the Cape, which Rust reared from *Saissetia persimilis* collected at Durban, Natal. At Entebbe, Uganda, the writer reared specimens also indistinguishable from Cape Town samples, from an unidentified *Saissetia*; none were reared from *S. oleae*, although the two species of *Saissetia* existed side by side.

### SPECIES OTHER THAN COCCOPHAGUS PARASITIC IN BLACK SCALE

#### COCCIDOXENUS NILOTICUS N. SP.

*Coccidoxenus niloticus* (fig. 1) closely resembles *C. obscuratus* Waterston and *C. ugandensis* Compere. *C. obscuratus* is described as having the forewings tinted beyond the clear cross band, and the frontovertex as measuring one sixth of the head width. In the new species, the frontovertex is one fourth the head width and the integument of the forewings is

not tinted beyond the clear cross band. In *C. ugandensis* the frontovertex is one fifth the head width and the ocelli are in an equilateral triangle, whereas in the new species the posterior ocelli are plainly closer to each other than to the anterior ocellus. In *C. ugandensis* the scrobes are not so sharply acute nor so deeply impressed above as in *C. niloticus*.

*Female*.—General color blackish; posterior three fourths of scutellum refringent bluish green blended with violaceous; frontovertex and face faintly bluish green; scrobes strongly refringent; corners of propodeum with bluish-green reflections. An-

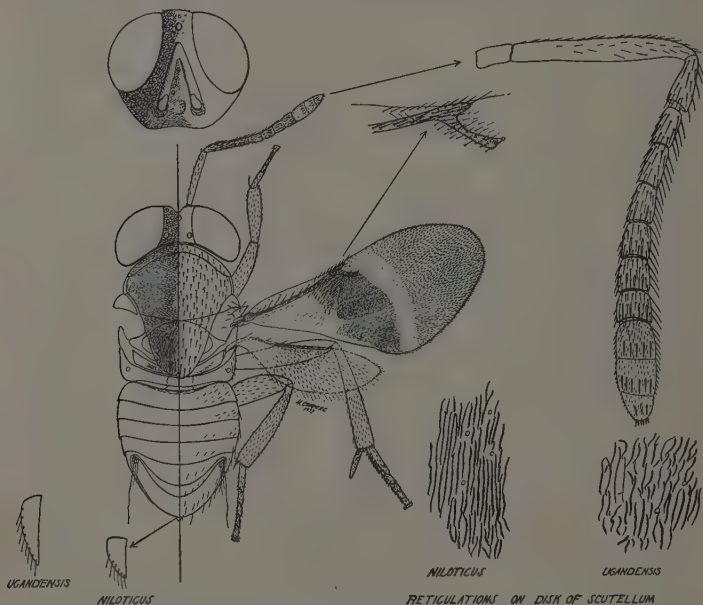


Fig. 1.—*Coccidozenus niloticus* n. sp.; female. Parts of *Coccidozenus ugandensis* Compere and *C. niloticus*, as labeled, for comparison.

tennae testaceous grading to blackish toward club. Tibiae of fore and middle legs mostly straw-colored; tibiae of hind legs dominantly blackish with only the ends straw-colored; all legs with the knees and tarsal joints more or less straw-colored; middle femora with a pale annulus near basal ends.

Eyes weakly pubescent, appearing bare under low magnification. Punctations of the head with weak, appressed, whitish setae. In balsam the posterior and apical parts of hind wings almost invisible, except beneath marginal vein, the cilia appearing transparent and the outline of the blade difficult to detect.

Forewings slightly more than twice as long as wide.

Length, 1.8 mm.



*Male*.—In color the males resemble the females. Head in dorsal view about two and one-half times as wide as frontovertex (27:11); frontovertex plainly wider than long. Ocelli in an obtuse triangle, the posterior pair about one half their own diameter from the orbits and occipital margin. Antennae mostly dark brown; each funicle joint provided with two whorls of long, curved setae. Forewings hyaline covered with fine whitish setae that become transparent in balsam.

Described from thirty-five females and eleven males, holotype, allotype, and paratypes, propagated on *Saissetia oleae* in the insectary at Riverside.

The stock now being propagated in each of several insectaries is descended from one female and two males obtained by S. E. Flanders from black scale collected on oleanders at Nairobi, Kenya Colony, on June 18, 1937, shipped June 19, and received at Riverside July 3.<sup>10</sup>

Specimens were reared in October, 1937, from black scale infesting citrus and collected at the Power Ranch in Ventura County, California, where colonies had been released.

#### DIVERSINERVUS MASAKAENSIS N. SP.

The generic relation of *Diversinervus masakaensis* n. sp. is shown best by the *Diversinervus*-like character of the head and wings. If one is not familiar with *Diversinervus*, this species might be identified as a species of *Cheiloneurus* or a representative of a new genus. In *Diversinervus* the head is more horizontal than vertical, in dorsal aspect the frontovertex is expanded on each side anterior to the orbits, forming a frontal ledge; face inclined strongly ventro-caudad, meeting the frontal ledge above in a sharp angle; orbits horizontally elongated, more dorsal than lateral. The shape of the wings, venation, infuscation, and ciliation are fundamentally similar in all known species of *Diversinervus*. The mesoscutar tuft is absent. This species can be at once separated from *Diversinervus smithi* by the widely expanded scape, transverse funicle joints, and short, wide club. There are marked thoracic differences but these cannot be described with too much assurance, since *Diversinervus masakaensis* is represented by one specimen which has partially shriveled. In drying, the posterior part of the frontovertex has folded upward and the mesoscutum and scutellum have become sunken. The thorax appears definitely flattened; the scutellum is wider than long (18:15), and the disk is plane instead of sloping on either side of the median line; the

<sup>10</sup> Biological note by S. E. Flanders: *Coccidoxenus niloticus* develops gregariously in mature hosts, usually two individuals in a single host. The sex ratio is five females to one male. The life cycle, at about 80° F, is from 15 to 16 days. Maple has described and figured the ovarian and deposited eggs and the newly hatched larva of this species. (Maple, John D. The eggs and first instar larvae of Encyrtidae and their morphological adaptations for respiration. Thesis for the degree of Doctor of Philosophy, University of California, 1940. Typewritten. Copy on file at the University of California Library, Berkeley.)

axillae are not deeply vertical posteriorly nor greatly elevated above the base of the scutellum.

*Female*.—Dorsum of thorax mostly golden yellow; posterior margin of mesoscutum metallic bluish near center; collar of pronotum faintly silver or translucent whitish; lateral posterior corners of propodeum dark metallic, highly refringent; corners of mesopleura adjacent to propodeum with dark metallic suffusion; abdomen mostly dark metallic, brownish toward the apex on the sides and darker and more refringent across the base. Frontovortex mostly shining brown, darker and more metallic posteriorly; face and cheeks testaceous without a dark cross band. Forelegs with coxae, trochanters, and basal half of femora white or colorless, the remainder testaceous. Scape mostly testaceous, whitish near the apex, and blotched fuscous near ventral margin toward middle; dorsum of pedicel dark brown, remainder white; all funicle joints and club dark brown. Middle legs with coxae, trochanters, and most of the femora white; tibiae banded with white near basal ends, extreme bases fuscous-tipped, below the white band tibiae dark brown grading to testaceous apically. Hind legs with coxae and trochanters white, femora testaceous, tibiae mostly brown, testaceous at apical ends.

Frontovortex much wider than in other species, occupying more than one third the head width (10:27); furnished with setae comparable to those on the eyes; occipital margin with two longer, erect setae. Mesoscutum with sparse, short, black setae scattered anterior to the middle. Scutellar tuft upright, divided in the middle; the longest of the coarse, black setae about as long as one third the width of the scutellum. Abdomen shorter than thorax (4:5); ovipositor concealed.

Scape expanded, twice as long as wide; pedicel one and one-half times as long as wide; funicle joints all wider than long, the first four subequal, the fifth and sixth much the largest, the sixth a trifle more than twice as wide as long. Club about as long as the funicle joints united and almost twice as wide as the preceding funicle joint. (Described from a dried antenna mounted in balsam.)

Forewings fundamentally similar to those of *Diversinervus smithi* (fig. 2), the minor differences being as follows: Submarginal vein with four long setae evenly spaced, three setae opposite the hyaline area and one opposite the basal infuscated area. Speculum bounded at inner margin by sixteen coarse, black setae in three diagonal rows.

Length, 1.0 mm.

Described from one female, holotype, labeled insectary no. A-211.

Insectary no. A-211 was given to a shipment of black-scale material dispatched from Kampala July 14, and received in Riverside July 27, 1937. The material consisted of parasitized *Saissetia oleae* on aerial roots of a *Ficus* sp. and on oleander canes collected in the town of Masaka, Uganda.

#### DIVERSINERVUS SMITHI N. SP.

*Diversinervus* sp. Flanders (1939a, p. 152).

Because of the absence of a mesoscutar tuft in the females, *Diversinervus smithi* n. sp. (fig. 2) might be mistaken for a species of *Cheiloneurus* or the representative of a new genus. The absence of a mesoscutar tuft

readily distinguishes *D. smithi* and *D. masakaensis* from previously described species of *Diversinervus*.

*Female*.—Thorax mostly testaceous or diluted with golden brown; posterior one third to one half of mesoscutum dark metallic with refractive setae that appear silvery or golden in dried, tag-mounted specimens and transparent in balsam-mounted

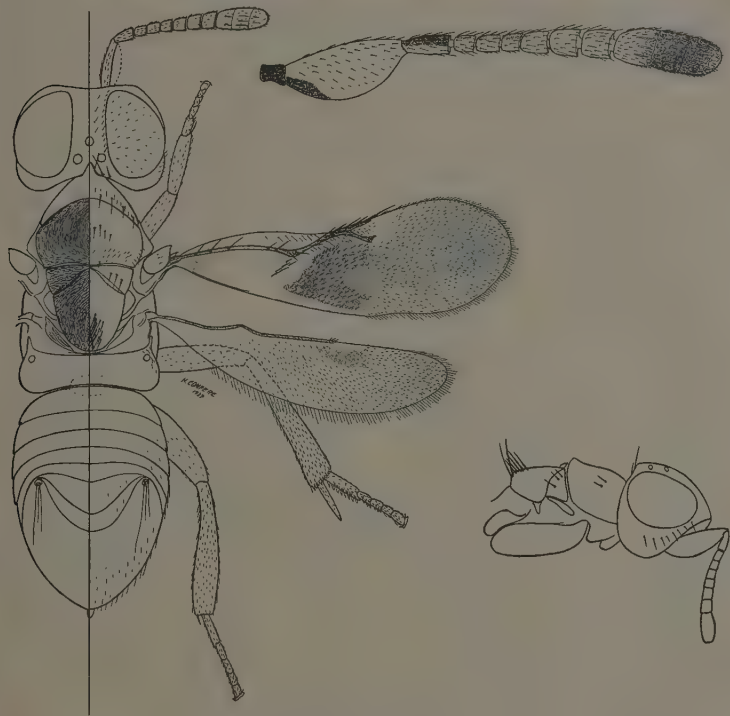


Fig. 2.—*Diversinervus smithi* n. sp.; female.

specimens; scutellum with blackish suffusion on the sides near apex; sides of propodeum dark metallic behind the spiracles; tegulae with slight blackish suffusion near the outer margins. Mesoscutum with translucent explanate sides. Frontovortex testaceous, smooth, and polished; each orbit margined by a row of fine setae; similar setae, comparable in size and color to those on the eyes, in two parallel submedian rows on the frons; occipital margin with two erect, long, black setae and six or so smaller, suberect, black setae. Face shining pallid white or colorless with a conspicuous black band across face and cheeks at the level of the antennal sockets; cheeks below the band concolorous with face, grading to yellowish above band. Eyes yellow. Mandibles colorless basally, brown to blackish toward ends. Scape testaceous, ventral margin with narrow blackish marking; dorsal aspect of pedicel dark brown to black, sides and ventral part white or colorless; first four funicle joints partly testaceous, dorsally



longitudinally streaked with dark brown; fifth and sixth funicle joints and basal club joint testaceous; apical two club joints blackish. All coxae and trochanters transparent white; front and middle femora mostly concolorous with coxae, only distal ends testaceous or brownish; hind femora with basal third concolorous with coxae, distal part translucent testaceous; front tibiae and tarsi translucent, testaceous; middle and hind tibiae at basal ends banded with white and marked with dark brown on either side of the white, the remainder translucent testaceous; hind tarsi mostly white; middle tarsi testaceous. Prepectus with blackish marking. Mesopleura translucent, slightly testaceous. Abdomen generally testaceous with some brown or blackish admixture basally and on the sides and venter.

Frontovertex horizontal, four times as long as wide, deeply emarginate posteriorly, the indentation extending almost to a line tangent with the posterior margins of the lateral ocelli. Ocelli in an acute triangle, anterior ocellus about its own diameter from the orbits; posterior ocelli slightly more than their own diameter apart, less than half a diameter from the orbits and fully twice their own diameter from the occipital margin, exclusive of the indentation.

Abdomen before shrinkage, plump, about as long as the thorax, slightly rounded at apex; ovipositor sheaths shortly exerted.

Otherwise as shown in figure 2.

Length, 1.8 mm.

*Male*.—Head lemon yellow, readily distinguishing the males of this species from those of *Diversinervus desantisi* Compere, *D. elegans* Silvestri, and *D. scutatus* Compere, which have dark metallic heads. Mesoscutum and scutellum mostly dark metallic, the former with some admixture of testaceous on sides; abdomen much darker than mesoscutum and scutellum and only faintly metallic. Color reflections variable, scutellum dominantly greenish blue and mesoscutum with purplish predominant. Axillae lemon yellow on basal half, blackish on apical half. Axillae slightly suffused with dark brown. Sides of propodeum lemon yellow anterior to spiracles, dusky posteriorly. Sides and sternum of thorax mostly testaceous. Legs about like those of female except darker markings not so distinct in males. Scape concolorous with face; flagellum slightly brownish.

Head in dorsal view, lenticular; frontovertex about as wide as long and occupying a trifle less than one half the head width; ocelli large, in a right-angle triangle or nearly so; posterior ocelli slightly less than their own diameter from the orbits and about half as far from the occipital margin; anterior ocellus about its own diameter from the posterior pair.

Described from fifty-seven females and ten males, holotype, allotype, and paratypes.

Besides the type specimens, several hundred specimens of the same lots have been preserved unmounted. All specimens were propagated on *Saissetia oleae* in the Citrus Experiment Station insectary at Riverside, California. These specimens are descendants of five females and one male reared at Riverside in May, 1937, from black scale collected on oleanders at Johannesburg, Transvaal, April 9, 1937.<sup>17</sup>

<sup>17</sup> Biological note by S. E. Flanders: *Diversinervus smithi* develops gregariously in black scale. Its life cycle is synchronized with that of its host and varies from 36 days to 6 months or more. Unlike many chalcidoids, the full-fed larvae do not form cocoons; consequently, a host from which a number of adult parasites have emerged will show only one exit hole.

## ENCYRTUS FULIGINOSUS N. SP.

*Encyrtus* sp. Compere (1931a, p. 255).

*Encyrtus fuliginosus* n. sp. (fig. 3) was first discovered in Eritrea, where it was parasitic in *Saissetia oleae*. It was not described but mentioned as *Encyrtus* sp. because of the writer's unfamiliarity with the species of this genus. Since it is the sole representative of this genus known to

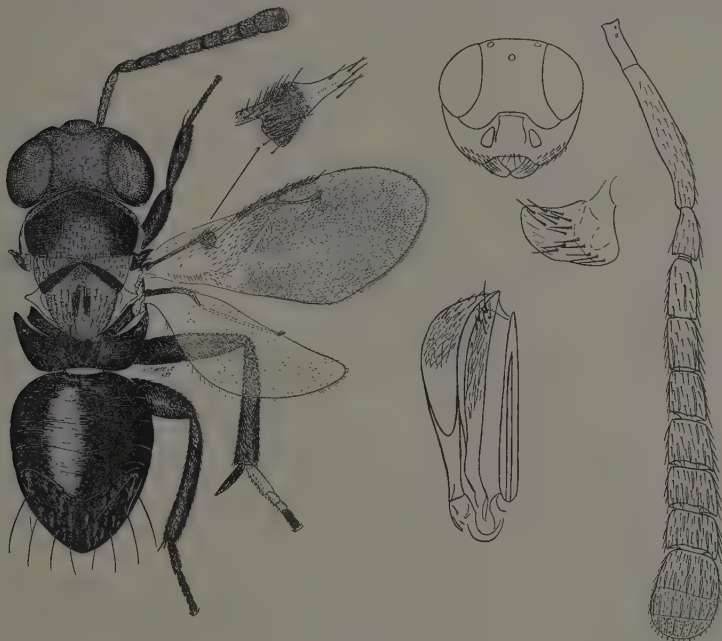


Fig. 3.—*Encyrtus fuliginosus* n. sp.; female.

parasitize black scale and since it is unlike any other African species either described or represented in the collection by undescribed species, it is assumed to be new and is described without reference to the descriptions of many species from other parts of the world.

*Encyrtus fuliginosus* is much more extensively dark colored than any of the other species known to the writer; the punctations on the head are very faint and the beard of coarse, black setae on the sides of the mouth is well developed. In life, the abdomen is tilted upward, a habit not previously mentioned with regard to any other species of *Encyrtus*.

*Female*.—Mesoscutum mostly if not entirely blackish or with variable ferruginous intrusions, the latter most pronounced anteriorly and toward the center; finely aero-

late-reticulate and covered with fine, soft setae that may appear either dark or translucent according to the play of light. Collar of pronotum blackish with variable ferruginous admixtures, provided with a posterior row of long, coarse, black setae. Axillae with the horizontal aspects mostly ferruginous, darker toward the inner tips and with sixteen or so black setae slightly coarser than those on mesoscutum; vertical posterior aspects blackish with patches of fine, silvery setae on outside. Scutellum dominantly ferruginous with faint golden reflections, except anteriorly near the middle where the color grades to dark brown or blackish; the tuft of coarse, erect, black setae divided in the middle and located posterior to the center; anterior part of scutellum having a narrow band of fine, silvery setae from side to side; these setae invisible in balsam; laterad of the scutellar tuft scattered black setae, comparable in size to those on the axillae; near apex a pair of long, slender setae as long as the setae composing the tuft. Tegulae blackish, more or less ferruginous, rather coarsely aerolate-reticulate basally, and striate-reticulate apically, furnished with coarse, black setae. Metanotum blackish between and adjacent to the coarse striate reticulations. Propodeum dominantly blackish with variable ferruginous admixtures. Abdomen black, paler on dorsum toward base. Frontovertex mahogany-colored or brownish blended with ferruginous, the dark color more pronounced near the ocelli; finely aerolate-reticulate with scattered faint punctations that give rise to microscopic, silvery setae. Cheeks submetallic, appearing very dark owing to the coarse, black striate reticulations; between the reticulations, the integument brownish yellow; laterad of the mouth coarse, black setae form a dense beard. Face between antennal sockets less coarsely reticulated than the sides of cheeks and with four strong, black setae projecting downward from the oral margin. Scape pale brownish yellow or colorless ventrally, more extensively pale near base than toward apex, most of sides and dorsum dark brown to blackish; flagellum dark brown to blackish except the ventral part of pedicel and apex of club, which are obscurely paler. Maxillary and labial palpi blackish. Mandibles brownish toward ends, the outer aspects with coarse, black setae comparable in size to those composing the beard. Mesopleura ferruginous, semitranslucent, revealing subsurface longitudinal striae. Prepectus translucent, brownish yellow or paler. Propleura, sides of pronotum, and prosternum ferruginous with blackish admixtures. Hind legs almost completely black, coxae and ventral aspects of tibiae toward bases diluted with dark brown. Middle legs with the first three or four tarsal joints pale brownish yellow, the remainder of legs blackish with obscure dark-brown dilutions. Forelegs similar to middle legs, except the tarsi, which are dark brown or blackish.

Length 2.5 mm.

Described from seventy females, holotype and paratypes, propagated on *Saissetia oleae* in the Citrus Experiment Station insectary at Riverside, California, 1937-38.

In this species, the thorax is less convex than in the others available for comparison, the scutellum is not so strongly elevated, and the disk is flatter. Aside from the lesser convexity of the thorax and the more plane scutellum, the head and body configuration does not appear essentially different from that of *Encyrtus infelix* Embleton and *E. barbatus* Timberlake. Unlike many species which have a dense tuft of coarse, black setae on the expanded part of the marginal vein, this species has relatively few setae, which do not obscure the details of the venation at this point.



No males of this species were reared from the African material. A few males were noticed after three generations of females had been propagated in the insectary.<sup>18</sup>

The original stock consisted of one hundred specimens, all females, reared from black scale on oleanders. This material was collected in Johannesburg, Transvaal, April 9, shipped April 10, and received at Riverside May 1, 1937. In Johannesburg, when the material was collected for shipment, *Encyrtus* females were noticed on the scale-infested oleanders. A single female issued at Riverside from material collected in Nairobi.

#### EUXANTHELLUS SP.

*Euxanthellus* sp. Smith and Compere (1928, p. 264-69). Compere (1936, p. 281-84).

There is uncertainty regarding the identity and host relations of the species of *Euxanthellus*. Some specimens were obtained from the Cape Town shipments, but the attempts to secure reproduction were unsuccessful and the specimens used in the experiments were lost. The failure of *Euxanthellus* to reproduce on black scale in the insectary at Riverside is attributed by Flanders to the possibility that the specimens which he obtained came from *Coccus hesperidum* which were mixed with black scale.

Few *Euxanthellus* were reared in Cape Town by the writer, and these were mostly males obtained from *Coccus hesperidum*. Two females, however, were reared there under circumstances which strongly indicate that black scale was the host. These two females issued in a breeding jar containing fifteen or so black scale on individual bits of *Podocarpus* twigs collected at Stellenbosch. There is not much chance that any *C. hesperidum* were present and accidentally overlooked.

There is also the evidence that *Euxanthellus philippiae* Silvestri, the form known from Eritrea, issues from black scale.

It is quite possible that at least two species exist and that Flanders attempted to propagate on black scale a species which attacks *Coccus hesperidum*.<sup>19</sup>

<sup>18</sup> Biological note by S. E. Flanders: *Encyrtus fuliginosus* is normally thelytokous; males rarely appear. It develops as a solitary parasite of immature scale and causes the host to become rounded and smooth, with a peculiar dark-brown appearance. The life cycle, at about 80° F, is 27 days. Maple has described and figured the ovarian and deposited eggs and the newly hatched larva of this species. (Maple, John D. The eggs and first instar larvae of Encyrtidae and their morphological adaptations for respiration. Thesis for the degree of Doctor of Philosophy, University of California, 1940. Typewritten. Copy on file at the University of California Library, Berkeley.)

<sup>19</sup> Biological note by S. E. Flanders: The males of *Euxanthellus* sp. are direct secondary parasites. The eggs of unmated females are fastened by a stalk to the outer surface of hymenopterous larvae parasitic in lecaniine scales. When reared at about 70° F, the life cycle is 31 days.

## MESOPELTIS SP.

In May, 1917, Masi erected the genus *Mesopeltis* for the species *atrocyanea* taken in the Seychelles Islands (Masi, 1917). Previously, in January, 1917, Waterston described the species *truncatipennis* from the Gold Coast and provisionally referred it to the genus *Eunotus* (Water-

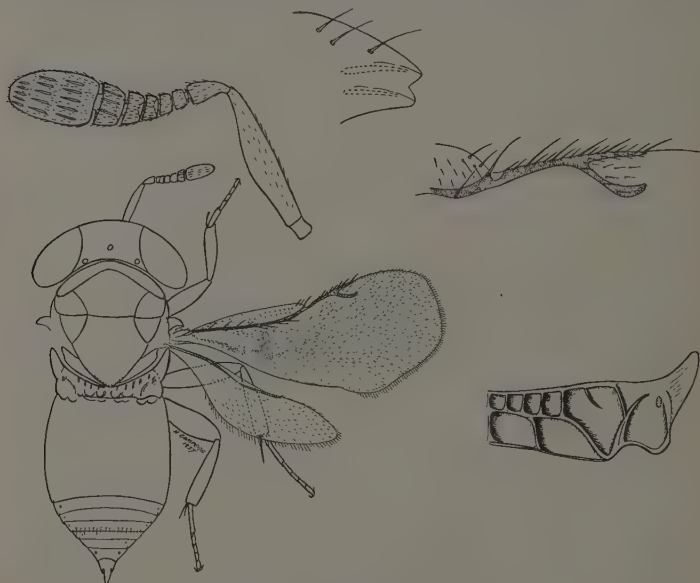


Fig. 4.—*Mesopeltis* sp.; female.

ston, 1917). Before Waterston's paper went to press, he had the opportunity to examine a cotype of Masi's species *atrocyanea*. In regard to these two species Waterston wrote:

There is in this collection a form close to *E. truncatipennis* for which Dr. Masi proposes to make a new genus. . . In general appearance the West African and Seychelles forms closely resemble one another, but the latter insect has some minute bristles on the radius and on the marginal and post-marginal in addition to the stouter bristles fringing the latter veins. The propodeon too, . . . is flatter (the area between the mid and first lateral comb being hardly higher than the spiracular area) and on each side slopes towards the mid line, instead of being almost perpendicular to it; the "teeth" are also less prominent. More material is required to determine the status of these forms. (Waterston, 1917.)

The species now being propagated on black scale in California (fig. 4) very closely resembles the two previously described species. It agrees

with *Mesopeltis atrocyanea* in all the characters described by Masi. Also, it seems to agree in general with Waterston's description of *M. truncatipennis*, except that there are a few setae on the marginal, postmarginal, and stigmal veins in addition to the coarser ones on the anterior margin of the wings, and the propodeum appears to be sculptured differently.

The sculpture of the propodeum appears fairly similar in the series of samples examined. Anteriorly on either side of the midline of the propodeum are three or four small, shallow fossae, separated from each other by longitudinal carinae; laterad of the small fossae and still on the anterior portion is a large, irregular fossa which is bounded laterad by a carina curving inward from near the spiracles. Posteriorly on either side of the midline are two large fossae at a lower level than are the small anterior fossae. On either lateral side of the posterior submedian fossa is a larger, more irregularly shaped fossa which is partly shadowed or overlapped by an elevated angular salient which arises near the spiracles and projects posteriorly.

If differences in the sculpture of the propodeum constitute a reliable character by which to separate species of *Mesopeltis*, the form mentioned here as *Mesopeltis* sp. is a different species from those previously described.

Under the name *Enargopelte ovivora*, Ishii (1928) described a species from Japan, the larvae of which feed on the eggs of a *Lecanium*. The Japanese species appears to be congeneric with the species mentioned as *Mesopeltis* in this paper.

The species of *Mesopeltis* now being propagated and colonized in California was obtained by S. E. Flanders from three lots of black-scale material collected in Uganda in July, 1937.<sup>20</sup> Four females were reared by the writer from black scale taken on oleanders at Uitenhage, Union of South Africa, January 12, 1937.

<sup>20</sup> Biological note by S. E. Flanders: *Mesopeltis* sp. develops gregariously beneath mature black scale, feeding only on the scale eggs. Two dozen individuals may develop under one large host. The life cycle is about 26 days: incubation period 4 days, first larval instar 2 days, second instar 2 days, third instar 4 days, prepupal period 2 days, and pupal period 12 days. On the fourth day of the third instar, the larva spins a cocoon under its host. The cocoon changes in color from white to reddish brown. The cocoon material, as in other chalcidoids, issues from the anus of the full-grown larva. The egg is covered with fine papillae and possesses a slender stalk. The newly hatched larvae possess four pairs of spiracles. Larvae of the second and third instars each possess nine pairs of spiracles. Four fine yellowish bristles occur on each of the abdominal segments except the last and characterize all stages of the larva. These yellowish bristles serve to distinguish larvae of *Mesopeltis* from those of *Scutellista*.



**METAPHYCUS HELVOLUS (COMPERE)**

*Aphyous helvolus* Compere (1926, p. 25-29).

*Euaphycus helvolus* (Compere). Smith and Compere (1928, p. 274). Compere (1931a, p. 252-53).

*Metaphycus helvolus* (Compere). Compere (1940, p. 29).

*Metaphycus helvolus* is one of the species successfully propagated in the insectary at Riverside and colonized in California.<sup>21</sup> In the fall of 1937, numerous specimens were recovered from an orchard in Ventura County where some of the first liberations had been made. The stock propagated in California was obtained from black scale collected in Cape Town and vicinity. What presumably is a reference to the same species is mentioned in the insectary notes under no. A-205, where a note is made of the rearing of forty *Metaphycus* sp. from material collected in Pretoria and Johannesburg.

**METAPHYCUS LOUNSBURYI (HOWARD)**

*Aphyous lounsburyi* Howard (1898, p. 241-44). Smith and Compere (1928, p. 275-91).

A complete bibliography of *Metaphycus lounsburyi* is given in an earlier paper (Smith and Compere, 1928). Maple<sup>22</sup> has redescribed the ovarian egg of this species in detail.

*Metaphycus lounsburyi* was not reared by the writer in Africa from the many lots of material sampled in Cape Town. But a few specimens were reared at Riverside from the Cape Town shipments. At Clan William, about 150 miles from Cape Town, black scales parasitized by *M. lounsburyi* were found.

<sup>21</sup> Biological note by S. E. Flanders: *Metaphycus helvolus* is a solitary parasite of various lecaniine scale insects. The female inserts stalked eggs in the dorsum of young scales, and the parasitized hosts can be identified by the protruding egg stalk.

The life cycle is short. When reared at about 80° F, adults appear from 12 to 13 days after oviposition. The incubation period is 3 days; first, second, and third instars, together, 2 days; fourth instar 1 day, prepupal period 1 day, and pupal period 6 days. The life cycle of the male is 1 day shorter than that of the female.

In the first two instars, the larvae possess two pairs of caudal spiracles, which are appressed to the respiratory plate of the egg. The larvae of the third instar possess the typical nine pairs of spiracles.

Hosts from which this parasite has emerged vary from 0.75 to 1.75 mm in length. As the parasite consumes the host's contents, the derm of the host becomes light brown in color, similar in appearance to that of hosts parasitized by *Metaphycus stanleyi* or *M. lounsburyi*.

*Metaphycus helvolus* appears to be the most effective of the parasites of black scale in California, particularly where the broods of scale are uneven. *M. helvolus* develops so rapidly that it may have three generations to one of the host. The adult parasites disperse widely and are active throughout the year. Unlike *M. lounsburyi*, *M. helvolus* is not limited to one host species. Enormous numbers have been reared in the insectary.

<sup>22</sup> Maple, John D. The eggs and first instar larvae of Encyrtidae and their morphological adaptations for respiration. Thesis for the degree of Doctor of Philosophy, University of California, 1940. (Typewritten.) Copy on file at the University of California Library, Berkeley.

**METAPHYCUS NATALENSIS COMPERE**

*Metaphycus natalensis* Compere. Smith and Compere (1928, p. 291-92).

*Metaphycus natalensis* was obtained in 1925 by Rust, in Natal, where it was reared from black scale. It was not obtained from the 1936-37 shipments. Ten days were spent by the writer in Natal, but no black scales were found.

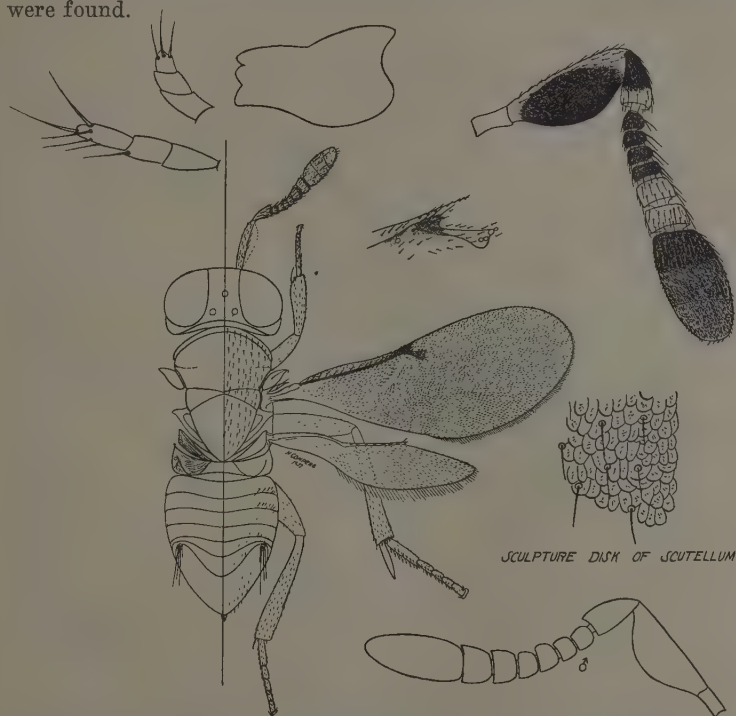


Fig. 5.—*Metaphycus stanleyi* Compere; female, except for male antenna, as indicated.

**METAPHYCUS STANLEYI COMPERE**

*Metaphycus stanleyi* Compere (1940, p. 10-11).

*Metaphycus stanleyi* (fig. 5) is a small-sized species ranging near 1.0 mm in length. This species agrees with *M. insidiosus* Mercet in having both maxillary and labial palpi three-jointed, but differs from the latter in having testaceous to whitish cheeks which are not plainly marked with blackish color and legs which are not distinctly banded. In some respects *M. stanleyi* is not greatly unlike *M. lounsburyi* (Howard), but the latter is much larger than *M. stanleyi* and colored differently. In *M.*

*lounsburyi*, the scape is about three times as long as wide, the integument opaque, and the parapsidal sutures are more distinct. In life, when *M. stanleyi* and *M. lounsburyi* are viewed side by side, the abdomen of the former appears decidedly darker. In *M. lounsburyi*, the venter of the abdomen is almost solidly whitish and opaque, whereas in *M. stanleyi* it is partly brownish distally and grayish white basally.

*Female*.—Dorsum of head orange yellow; face and cheeks grading from yellowish above to whitish below; occiput blackish above the neck, with blackish suffusions on either side below; dark coloration on sides of occiput often visible through the semi-translucent integument of the cheeks. Mesoscutum, axillae, and scutellum orange yellow, sometimes with grayish admixtures, covered with white or golden setae. Concealed part of pronotum blackish, collar white with a dark spot on either corner. Tegulae whitish basally and dusky apically. Sides and sternum of thorax and underpart of abdomen on basal half or so grayish white. Metanotum, propodeum, and dorsum of abdomen dark brown to blackish. Scape mostly blackish, the ends and dorsal margin white. Basal half of pedicel blackish, apical half white. First four funicle joints and club dark brown to black; fifth and sixth funicle joints pale testaceous. All coxae, trochanters, and femora translucent white. Tibiae of middle legs mostly pale testaceous grading to whitish with a dusky incomplete bandlike suffusion near base and a fainter suffusion on the apical third; front and hind tibiae less distinctly marked with dusky suffusions.

Frontovertex one and two-thirds times as long as wide, microscopically punctate-reticulate, with almost imperceptible fine setae similar to those on eyes; ocelli in acute triangle, the posterior pair once their own diameter from the occipital margin and about half this distance from the orbits.

Scape two and one-half times as long as wide. Parapsidal sutures not always visible in tag-mounted specimens.

Other characteristics as shown in figure 5.

*Male*.—Frontovertex about twice as long as wide, pale lemon yellow, microscopically reticulate-punctate and covered with fine, white setae. Ocelli in an acute triangle, posterior ocelli almost their own diameter from the occipital margin and half this distance from the orbits. Scape and pedicel colored as in the female, funicle joints and club slightly brownish. Face and cheeks white. Notum of thorax as in the female. Dorsum of abdomen mostly dark brown above, yellowish on sides, and grading to white beneath. Legs mostly translucent white to faintly yellowish without distinct darker markings.

Described from forty females and thirty-five males, holotype, allotype, and paratypes, propagated on *Saissetia oleae* in the Citrus Experiment Station insectary at Riverside.

The California stock was propagated by S. E. Flanders from 150 specimens obtained from black scale on oleanders imported from the Union of South Africa.<sup>23</sup> The parasitized scales were collected in a door-

<sup>23</sup> Biological note by S. E. Flanders: *Metaphycus stanleyi* develops as a solitary or gregarious parasite of various lecaniine scales. Oviposition is accomplished rapidly, the egg being inserted in the host either at the anterior or posterior margins, so that the egg stalk protrudes in the marginal line of hairs. The life cycle, at about 80° F, is two weeks. The sex ratio is determined by the size of the hosts; the mated female deposits only male eggs in hosts less than 1 mm. in length. *M. stanleyi* appears to effectively control soft brown scale and black scale, under certain conditions.

yard near the industrial district in the city of Cape Town, March 14, 1937. The shipment was received at Riverside, March 29, and given insectary no. A-98.

*Metaphycus stanleyi* was present in one lot of material collected in the Union of South Africa. The species is not represented in the collection made there by Rust, nor were specimens reared by the writer in Cape Town from samples collected in other parts of the city. What appears

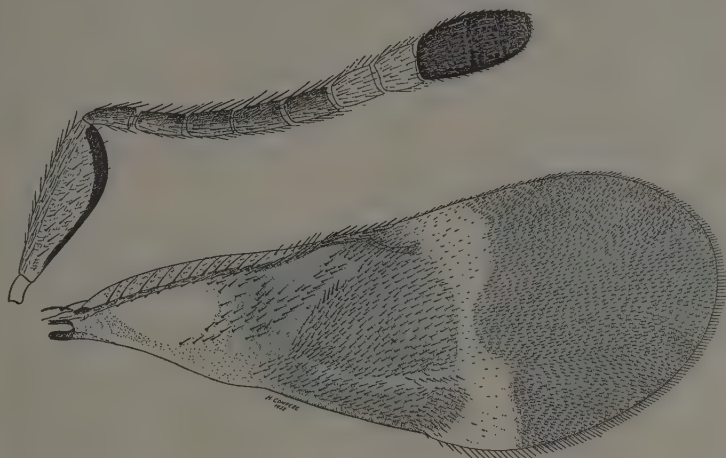


Fig. 6.—*Microterys kenyaensis* Compere; female.

to be the same species is represented by two females bearing the insectary no. A-211. Under this number the insectary notes show that fourteen specimens issued from black scale collected at Masaka, Uganda, July 13, 1937.

#### MICROTERTYS KENYAENSIS COMPERE

*Microterys kenyaensis* Compere (1939a, p. 16).

*Microterys kenyaensis* (fig. 6) is a moderate-sized species, almost completely testaceous with slightly expanded scape and one transverse clear band on the forewings.

*Female*.—Head lemon yellow to testaceous with the oral margin narrowly marked with black. Integument of thorax semitransparent, mostly testaceous; metanotum, center of propodeum, and vertical outer sides of axillae and vertical sides of anterior part of scutellum blackish. Mesoscutum and scutellum with a faint violaceous luster in some lights. Abdomen dark metallic basally, testaceous apically, the two colors not sharply separated. Scape testaceous with the ventral margin bordered with blackish; pedicel and first four funicle joints fuscotestaceous and covered with dark setae; fifth and sixth funicle joints white, covered with fine, pale setae; club black. Legs entirely testaceous.

Mesoscutum covered with dark setae that increase in size posteriorly. Scutellum



with the anterior two thirds covered with setae comparable in size to those on the posterior portion of mesoscutum; extreme apex of scutellum with a pair of closely spaced, long, pale setae; setose portion of disk terminating in a preapical pair of widely spaced, curved, black setae which are coarser than the apical pair.

Thorax moderately convex, scutellum well rounded from side to side but not elevated above the mesoscutum as seen in profile. Abdomen shorter than thorax; ovipositor shortly exerted.

Frontovertex one fifth as wide as head and about four times as long as wide, but appearing only slightly more than three times as long as wide if viewed in one focal plane without regard to the curvature; finely punctate-reticulate with four rows of faint setiferous punctations anterior to the median ocellus; ocelli in an acute triangle, the posterior pair almost contiguous with the orbits and almost twice their own diameter from the occipital margin. Head frontal view, a trifle wider than high (31:28); eyes descending about two thirds the depth of the head (17:28); scrobes very wide and shallow, confluent and broadly semicircular above. Mandibles with two small but clearly defined ventral teeth and a rounded dorsal corner, which produce a tridentate effect.

Length, 1.8 mm.

Described from one female, holotype, taken at Nairobi, Kenya Colony, June 17, 1937, near *Saissetia oleae* on oleanders that were being collected for shipment to California.

The insectary notes show that in July, Flanders obtained two female *Microterys* from black scale collected at Nairobi, June 17, 1937. The two females obtained by Flanders were placed in a cage with black scale. They produced the male progeny which are described here. These males, which were propagated in the quarantine room of the Citrus Experiment Station insectary at Riverside, are thought to be the opposite sex of the species represented by the one female captured at Nairobi. Because of the possibility that this belief may be incorrect, the males are not considered as type material and are referred here only tentatively.

*Male*.—Head, notum of thorax, and abdomen mostly dark metallic; sides and sternum of thorax and legs mostly testaceous to pale straw color with the hind tarsi fuscous. Head metallic bluish green; scape pale lemon yellow, remainder of antennae dark brown. Collar of pronotum, mesoscutum, axillae, and scutellum blackish with slight metallic bluish-green reflections. Tegulae pale yellow. Lateral margins of mesoscutum may be edged with testaceous. Metanotum and propodeum mostly nonmetallic black, sides of the latter shining bluish green, concolorous with base of abdomen.

Head dorsal view, distinctly lenticular; frontovertex almost one half head width, plainly wider than long, finely punctate-reticulate; ocelli in an obtuse triangle, median ocellus anterior to the middle, posterior pair about one half their own diameter from the orbits and occipital margin.

#### MICROTERTS SAISSETIAE COMPERE

*Microterys saissetiae* Compere (1939a, p. 16).

*Microterys saissetiae* (fig. 7) is a robust species with the notum of thorax only slightly convex, the disk of scutellum almost plane and slightly depressed below the plane of mesoscutum. Before shrinkage,

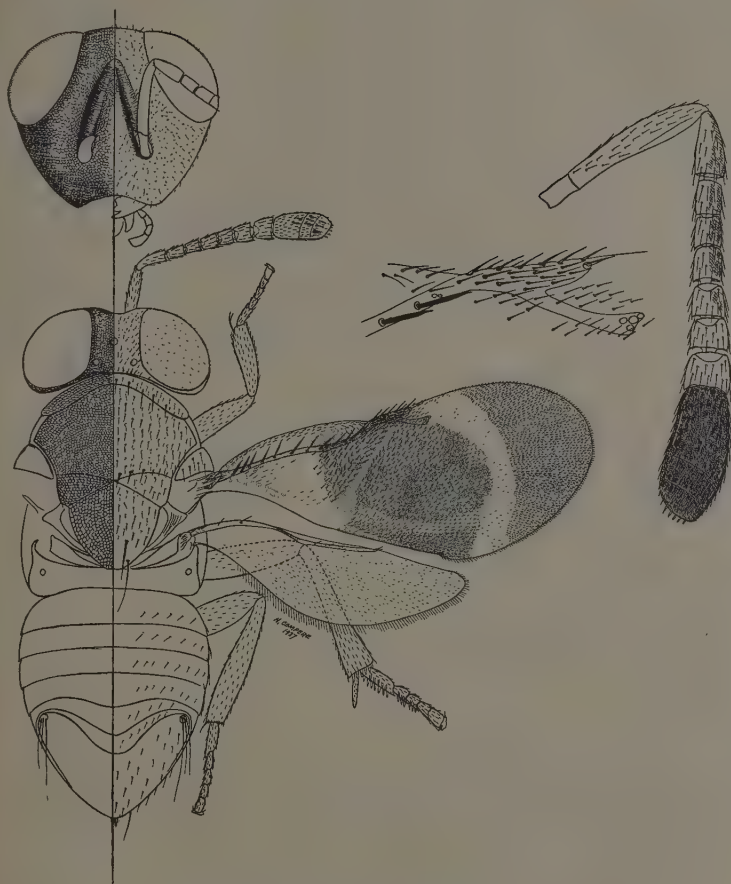


Fig. 7.—*Microterys saissetiae* Compere; female.

the abdomen appears about as long as the thorax, rounded at apex, ovipositor not exerted. After shrinkage, the abdomen appears much shorter than the thorax, triangular in outline, but rounded at apex.

*Female*.—Antennal club, center of occiput adjacent to neck, and abdomen black, the latter shining and faintly metallic in parts. Mesoscutum, except narrowly around the margins, dark metallic with strong purple, green, and blue reflections. Head, pronotum, margins of mesoscutum, tegulae, axillae, scutellum, metanotum, propodeum, sides and sternum of thorax, and legs mostly orange or brownish yellow to golden yellow. Apical one third or so of scutellum slightly dark with purple or bluish-metallic reflections. Apical half of tegulae slightly dusky, the effect produced by

fuscescent reticulations. Pedicel, first four funicle joints, and basal ends of middle and hind tibiae with faint dusky suffusions.

Head, mesopleura, axillae, and scutellum finely punctate-reticulate, appearing granular under low magnification. Much of the vestiture refractive, the small setae on the axillae and anterior half of the scutellum appearing golden. Vertex, collar of pronotum, margins of mesoscutum, tegulae, and apical third of scutellum with blackish setae. Apex of scutellum with two pairs of long setae, the preapical pair slightly compressed and black, the apical pair semitransparent, slender, and longer than preapical pair.

Head in frontal view about as wide as high (14:13); eyes descending much less than half the depth of the head; antennae inserted about midway between the oral margin and eyes; scrobes deep, triangular, the inner sides almost vertical. Frontoververtex slightly longer than wide (10:8) and occupying between one fourth and one third the head width (8:27). Ocelli in a right-angle triangle or nearly so, the posterior pair about once their diameter from the occipital margin and about one half their diameter from the orbits.

Length, 1.7 mm.

*Male*.—General color dark metallic. Wings hyaline. Head mostly greenish blue, cupreous near the ocelli. Scutellum slightly greenish. Mesoscutum less brilliant than the scutellum but with more varied reflections. Scape pale yellow, remainder of antennae dark brown. Legs translucent white to pale-straw-colored except coxae of middle legs and coxae, femora, and tibiae of hind legs, which are dark brown as follows: coxae entirely, femora except ends, basal two thirds or so of tibiae suffused mostly on the dorsal aspect.

Frontoververtex much wider than long (11:7) and occupying about one half the head width (11:23). Ocelli in an obtuse triangle, the posterior pair almost contiguous with the occipital margin and about one diameter from the orbits.

Described from forty females and sixteen males, holotype, allotype, and paratypes, propagated on *Saissetia oleae* in the Citrus Experiment Station insectary at Riverside, 1937-38.

The California stock was propagated from one female and two males which issued from black scale collected at Masaka, Uganda.<sup>24</sup> The material was collected July 13, shipped July 14, and received at Riverside July 27, 1937.

What appears to be the same species was reared by the writer from an undetermined *Coccus* sp. on *Muehlenbeckia* sp., Pretoria, Union of South Africa. In the collection of the Citrus Experiment Station is a series of males and females reared from *Saissetia persimilis* Newst. by E. W. Rust at Durban, Natal, February and March, 1927:

<sup>24</sup> Biological note by S. E. Flanders: *Microterys saissetiae* develops gregariously in rubber-stage black scale. The life cycle, at about 80° F, is 18 days. Maple has described and figured the ovarian egg and larva of this species. (Maple, John D. The eggs and first instar larvae of Encyrtidae and their morphological adaptations for respiration. Thesis for the degree of Doctor of Philosophy, University of California, 1940. Typewritten. Copy on file at the University of California Library, Berkeley.)

**SCUTELLISTA CYANEA MOTSCHULSKY**

*Scutellista cyanea* Motschulsky (1859, p. 171-73). Smith and Compere (1928, p. 322-32).

The complete bibliography of *Scutellista cyanea* is given in an earlier paper (Smith and Compere, 1928). *S. cyanea* was present in a number of shipments, but no attention was given to this species. It was exceedingly rare as a parasite of black scale in the Cape Town area. Most of the specimens of *Scutellista* collected were from species of *Ceroplastes*.

**THE SPECIES OF HYPERPARASITES****BAEOANUSIA MINOR (SILVESTRI)**

*Bothriothorax minor* Silvestri (1914, p. 292-93).

*Baeoanusia africana* Girault (1916a, p. 114).

*Baeoanusia minor*. Compere (1931c, p. 263-64).

In the insectary notes are numerous entries regarding the rearing of *Baeoanusia* sp. The specimens were destroyed in the quarantine room at Riverside.

**TETRASTICHUS INJURIOSUS COMPERE**

*Tetrastichus injuriosus* Compere (1926, p. 11-15).

*Tetrastichus injuriosus* was exceedingly numerous in many of the shipments of African black scale. The adults were destroyed in the quarantine room at Riverside.



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